ATOMIC STRUCTURE *(MODIFIED FOR ADEED)*

INSTRUCTIONS

Science Concept:

Atoms consist of protons, neutrons, and electrons.

Objectives:

The student will:

- collaborate as a group to brainstorm ideas; and
- successfully model an atom.

GLEs Addressed:

Science

[9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[9] SB1.1 The student demonstrates an understanding of the structure and properties of matter by describing atoms and their base components (i.e., protons, neutrons, electrons).

Vocabulary:

matter – the substance of which a physical object is composed; especially: the material substance that occupies space, has mass, and makes up the observable universe

atom – the smallest particle of an element that has the properties of the element and can exist either alone or in combination

nucleus – the central part of an atom that includes nearly all of the atomic mass and consists of protons and usually neutrons

proton - an atomic particle that occurs in the nucleus of every atom and carries a positive charge

neutron – an atomic particle that occurs in the nucleus of an atom and carries a neutral charge

electron – an atomic particle that has a negative charge of electricity and travels around the nucleus of an atom

electrical charge – a property of some subatomic particles, which determines their electromagnetic interaction

Materials:

- Clear glass jar
- Isopropyl alcohol
- Coffee filter, cut into strips (or filter paper)
- Green, water soluble marker
- M&Ms®
- Raisins
- Jelly beans
- Large, round paper plates (one per group)
- Marker (one per group)
- OVERHEAD: "Diagram of an Atom"
- OVERHEAD: "Atomic Notation"
- TEACHER INFORMATION SHEET: "Atomic Relay Cards"
- STUDENT WORKSHEET: "The Atoms Family Atomic Math Challenge"
- STUDENT WORKSHEET: "Atomic Structure"

Activity Procedure:

Please refer to the assessment task and scoring rubric located at the end of these instructions. Discuss the assessment descriptors with the class before teaching this lesson.

Gear Up

Process Skills: inquiry and hypothesizing

1. Ask students to gather around so that they can see the following demonstration.
2. Pour approximately 1 inch of isopropyl alcohol into a small clear jar.
3. Create a blot of ink with the green marker on the filter paper about 1 1/2 inches from the bottom.
4. Dip the bottom of the filter paper into the alcohol, but do not cover the ink.
5. Watch as the alcohol travels up the paper, carrying the ink along with it. After several minutes, two or three different colors of ink should appear.
6. Ask students to describe what happened and why. If necessary, explain that most ink is actuall composed of several different colors. How fast each color travels depends on the size of the dye molecule and how strongly it is attracted to the paper. The larger, heavier molecules do not travel as far and are seen on the bottom of the strip. The lighter, smaller molecules travel farther, and reveal themselves at the top of the strip.

Explore

Process Skills: classifying

7. Explain that just as the ink separates out into various colors, everything in the world is composed of small pieces called atoms. Even atoms have more than one part—a nucleus and a shell. If necessary, explain that a nucleus is the center part of an object, and the shell is the outer covering.
8. Divide the class into groups of three-to-four students and instruct each group to brainstorm a list of items that have a center and an outside that are made of different materials. Start by mentioning how an egg has a hard shell and a gooey center.
9. Ask groups to share their answers with the class. Create a master list of group answers on the board.
10. Show the OVERHEAD: "Diagram of an Atom," and explain that atoms could also be added to the list. If necessary, explain that atoms have a nucleus in the center and that electrons orbit the nucleus to form the shell.
11. Ask groups to revisit their lists and identify the part that is the center or nucleus for each item. Once groups have completed their lists, work as a class to add to the master list.
12. Explain that the nucleus of an atom is made up of two main parts—protons and neutrons. Write the definition of a proton on the board (see Vocabulary). Ask the class to come up with a way to remember that a proton is positively charged, such as "pro" means supporting something or feeling positive toward it. Work as a class to come up with a positive motion to represent protons, such as a thumbs up or smile.
13. Write the definition of neutron on the board (see Vocabulary). Explain that if something is neutral, it takes no sides. In this case, it means that the particle has no charge. Come up with a motion that indicates neutral for the neutron, such as an umpire's safe motion to show there is no out.
14. Show the OVERHEAD: "Diagram of an Atom" again and ask the class what surrounds the nucleus. Write the definition of electron on the board (see Vocabulary). Work as a class to come up with a motion to help remember than an electron is negatively charged, such as thumbs down or a frown.
15. Write the following sentences on the board:
    "The center of an atom is called the __. The nucleus is made up of two parts, the __ and the __. Protons have a __ charge and neutrons have a __ charge."
    Direct students to fill in the blanks and use the motions they have come up with while reading the completed sentences aloud.
16. Show the OVERHEAD: "Atomic Notation." Explain that the number of neutrons in an atom is the atomic number, written at the bottom of the element in the periodic table, minus the number of protons, equal to the atomic number. Complete a few examples by asking students to find the number of protons, electrons, and neutrons of several atoms on the periodic table of elements. (See TEACHER INFORMATION SHEET: "Periodic Table of Elements."

17. Hand out the STUDENT WORKSHEETS: "Atomic Structure" and candy. Allow time for students to complete the activity.

NOTE: If candy is not permitted in the classroom, or is unavailable, substitute different types of dried beans or different colors of beads for the neutrons, electrons, and protons used in the Student Worksheet.

18. Ask students to share their worksheet answers with the class. Review the characteristics of an atom.
19. Display the OVERHEAD: "Periodic Table of Elements." Ask students to identify two elements that have the same atomic composition. Explain that no two elements have the exact same atomic composition; each element is different.
20. Allow students to eat their candy when they are finished.

Generalize

Process Skills: inquiry, hypothesizing, inferring, and predicting

21. Ask students to create another atom of their own choosing by drawing it on paper.
22. Remind students that each element is different, but each has the same structure of protons, neutrons, and electrons.
23. Point out that each atom of an element has the same number of protons and electrons, which can be seen in the upper right hand corner of the element on the Periodic Table of Elements.

Apply

Process Skills: making models, classifying, and adding real numbers

24. Explain that the class will play a relay game. (A relay is when one person performs a task, then hands off the task to another person, and so on until the task is completed.) In this game, students will build a model of an atom, then hand over the model to the next student who will modify the model to make a different atom.
25. Put desks together, or move tables, so that there are two groups of four students each. Place the desks or tables so that they are side by side. Divide students into groups of four and assign two groups to play the first game. The remaining students will observe. Assign two observers to act as judges, one for each group.
26. Provide each group with a set of Atom Relay cards, candy, and a plate. Explain that one student will turn over a card and build a model of an atom. The other students in the group can assist verbally, but may not handle the card or the candy.
27. When the model is done the student should turn over their card and the next student in the group should grab a card and begin modifying the model to make the next atom.
28. Remind students that atoms have the same number of protons and electrons, and that the number of each can be seen in the upper right hand corner of the element notation. The number of neutrons in the atom is the mass number of the element minus the number of protons.
29. Judges should keep a tally of how many atoms are modeled correctly and how many are modeled incorrectly.
30. Play one round as an example.
31. Ask groups to choose their order, or choose for them, and explain they will have five minutes to model as many atoms as they can. When time is up, count how many atoms were done correctly by each group. The group with the most correctly modeled atoms wins.
32. Shuffle the cards and switch groups until every student has had a chance to play.

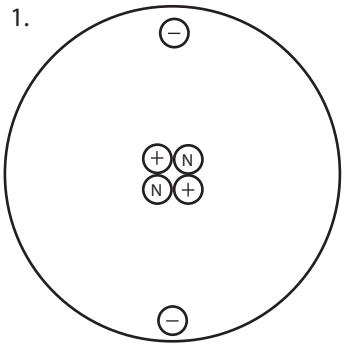
Extension Ideas:

Process Skills: hypothesizing, inferring, predicting, and making models

1. Discuss the different elements and how the atomic composition changes the characteristics of the elements.
2. Create a periodic table using the plate and candy method. (This will take a lot of candy! Using the first 30 elements should suffice.)

Answers to Student Worksheet:

1.



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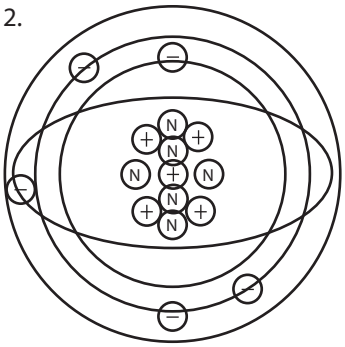

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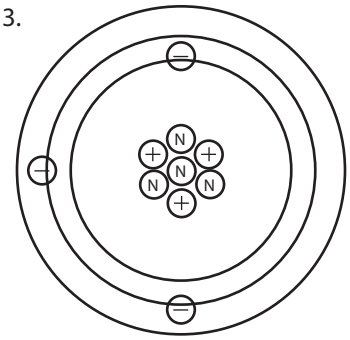
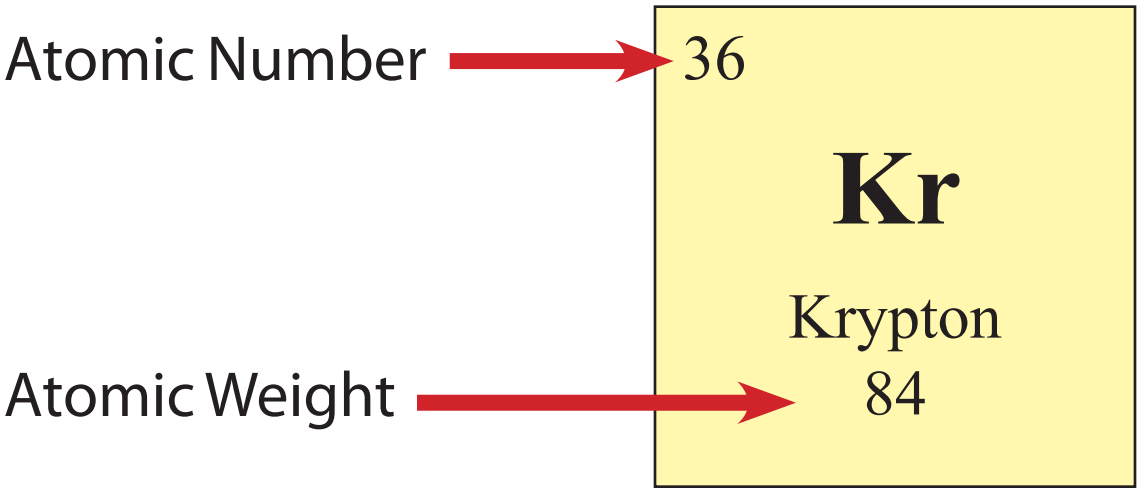


Rubric:

Objectives	GLE	Low Performance	At or Below Average	At or Above Average	Exemplary Performance
The student draws and labels a model of a Lithium atom.	SB1.1	Draws basic model (protons, neutrons, electrons).	Draws basic model (protons, neutrons, electrons), with each element in the proper location.	Draws basic model (protons, neutrons, electrons), with each element in the proper location and properly labeled.	Draws basic model (protons, neutrons, electrons, with each element in the proper location, properly labeled, and with the correct charge noted.
The student collaborates with others to brainstorm.	SA1.1	Student does not listen to others ideas and does not provide own ideas.	Student listens to others or provides own ideas, but not both.	Student listens to others ideas and provides own ideas.	Student provides own ideas, listens to others ideas, and makes connections between ideas.



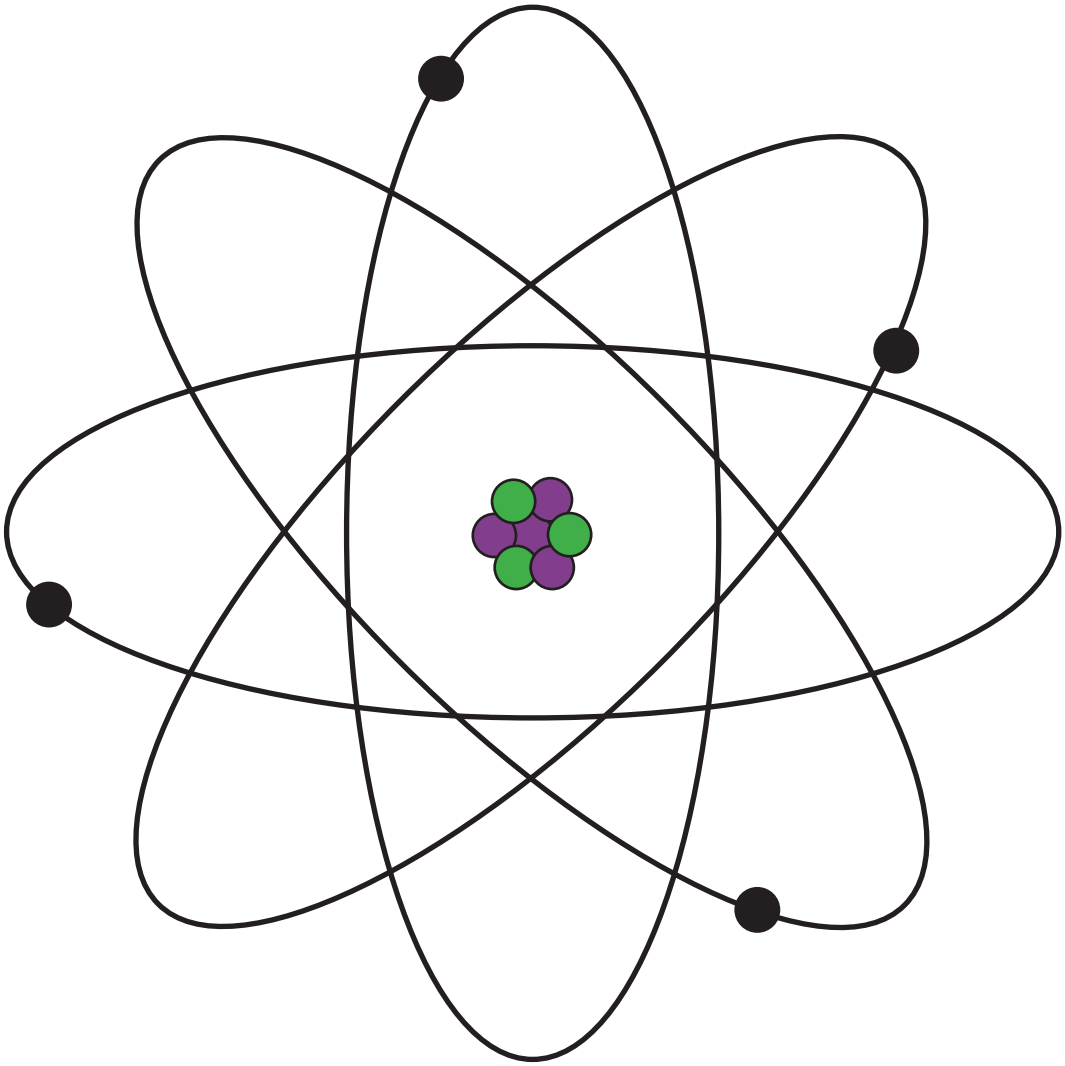
Atomic Number = Number of Electrons = Number of Protons
Atomic Weight is the same as relative atomic mass. The relative atomic mass rounded to the nearest whole number can be used as the mass number.

Mass Number = Number of Protons + Number of Neutrons

Number of Neutrons = Mass Number – Number of Protons

DIAGRAM OF AN ATOM

OVERHEAD



— Neutrons

— Protons

— Electrons

4 **Be** Berylium 9	11 **Na** Sodium 23	12 **Mg** Magnesium 24	19 **K** Potassium 39
20 **Ca** Calcium 40	2 **He** Helium 4	10 **Ne** Neon 20	9 **F** Fluorine 19
8 **O** Oxygen 16	7 **N** Nitrogen 14	6 **C** Carbon 12	5 **B** Boron 11
13 **Al** Aluminum 27	14 **Si** Silicon 28	15 **P** Phosphorus 31	16 **S** Sulfur 32
17 **Cl** Chlorine 35	18 **Ar** Argon 40	22 **Ti** Titanium 48	26 **Fe** Iron 56

NAME: _____ STUDENT WORKSHEET

ATOMIC STRUCTURE

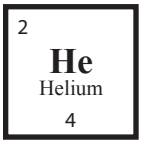
Materials:

- jelly beans
- M & Ms®
- raisins
- large, round paper plate
- marker

Materials:

Using the marker, draw a circle in the center of the paper plate. The circle should be about 2 inches in diameter. Using the candy and raisins, create the different atoms listed below. For this activity: jelly beans = electrons, M & Ms® = protons, and raisins - neutrons. **Remember:** *Neutrons and protons go in the center circle (nucleus), and the electrons orbit in the "shell."*

1. Model a helium atom using candy, then draw the atom below.



2. Model a boron atom using candy, then draw the atom below.

3. Model a lithium atom using candy, then draw the atom below.